

Introduction

U.S. Geological Survey personnel, in conjunction ith Mark Weber, Geologic Consultant to Missoula and well Counties, are studying the water and earth resources of an area that extends from the Big Fork and drangle on the north to the Avon quadrangle on the outh (see index map). This map is a product of that tudy, and is intended for use by environmental and land-use planners. Maps of quadrangles, or parts of quadrangles, south of Highway 200, have been prepared

The distribution of the alluvium was plotted in the office from aerial photographs. All other geologic units were mapped in the field.

Surficial deposits

Surficial deposits in the northern part of the ig Fork-Avon area were formed primarily during the atter stages of the latest ice ge--the Pinedale liciation of the Pleistocene. Glacial deposits intle the lower flanks of the mountains and form the alley floors; they have been dissected somewhat by streams, but most still appear much as when they were formed.

It seems likely that deposits of at least two laciers cover this quadrangle. One glacier advanced rom the north and overrode the low north end of the dission Range. Its deposits mantle that part of the inge is well as the low hills and rolling plain north of the range. The deposits of this northern glacier are shown on the map by the letter "n" added to the ymbol, thus, "Qon - Outwash of the northern glacier." nother younger glacier moved north down the Swan liver valley and came to a halt near the north end of wan Lake (east of this quadrangle). Some of its erminal deposits (Qtv) are exposed in the southeast orner of this quadrangle. In some localities deposto of more than one ice advance my have been inidvertently grouped and thus supped as the deposits of single advance.

DESCRIPTION OF MAP UNITS

ALLUVIUM (HOLOCENE) -- Light-brown to brown, fluvially deposited, uncon-olidated silt, sand, and gravel. Forms the unusually even floor of the Flathead River. Locally, near its outer margins, includes small deposits of colluvium and other mass-wasting debris. Bulk of material is silt and sand, but a few pebbles 13-25 mm (1/2-1 in.) in diameter are scattered throughout. Pebbles range in shape from subrounded to well rounded; most are rounded. Green, gray, and purple argillite, tan dolomite, and bluish-gray limestone clasts are common. Overlies outwash sand ind gravel deposited by glacial meltwaters

ALLUVIAL FAN (HOLOCENE) -- Light-brown to brown, low, broad, fan-shaped, gently sloping deposit of partly consolidated, moderately sorted silt, sand, and gravel. Lithologically similar to alluvium (Qal)

EARTHFLOW DEPOSITS (HOLOCENE) -- Partly consolidated, unsorted silt, sand, gravel,
cobbles, and boulders in a clayey matrix
forming a broad, lobate, hummockysurfaced, moderately sloping mass.
Probably formed when partly liquified
till moved downslope

MELTWATER DEPOSITS OF PINEDALE GLACIATION (PLEISTOCENE)

Drift--Composed of unconsolidated, moderately well sorted silt, sand, and gravel; broad, even to gently undulatory surface broken here and there by small till mounds and undrained depressions. These mounds protrude through the sand and gravel cap and rise some 2-6 m (6-20 ft) above the surrounding surface. Angular to subangular boulders 0.5-1.5 m (2-5 ft) in diameter are scattered across the till mounds. Elsewhere the even surfact of the sand and gravel deposit is interrupted by small rounded kettles 3-4.5 m (10-15 ft) deep. Sand and gravel deposit is light brown, and consists of subrounded to well-rounded clasts. In general, about 67 percent of unit is composed of clasts that range in size from about 5 mm to about 76 mm (1/4-3 in.) in diameter; about 31 percent consists of a fine to coarse sand with included small pebbles as much as 5 mm in diameter; and the remaining 2 percent is silt. Green, gray, and purple argillite clasts dominate deposit; tan quartzite and sandstone clasts are minor constituents. A few very large angular glacial erratics are scattered across the surface of the sand and gravel cap

rod-shaped deposit consisting of a thin venet of two colian and overlying till amount and attles. In places, a thin layer of stratified detritus is interported between the sand and the till took amount protrude through the sand cap locally, and rise some 1.5-3 m (5-10) is above the surrounding surface. A few angular boulders 0.5-1.5 m (2-11) in diameter are scattered across suffice of the drift

Outwash of the northern glacier--Lightbrown, unconsolidated, well-bedded and well-sorted silt, sand, and gravel. Includes a few interspersed cobbles 15-20 cm (6-8 in.) in diameter. Clasts range in shape from subrounded to well rounded; most are rounded. In general, about 37 percent of unit is composed of clasts that range in size from about 5 mm to about 76 mm (1/4-3 in.) in diameter; about 56 percent consists of fine to coarse sand with included small pebbles as much as 5 mm in diameter; and the remaining 7 percent is silt. Green, gray, and purple argillite clasts dominate deposit; tan dolomite, bluish-gray limestone, and gray diorite are minor constituents, as are well-rounded clasts of black basalt. Broad, unusually even surfaced deposit.

This deposit differs from outwash deposited by the north-flowing Swan River glacier in that it contains these well-rounded clasts of black basalt marked with small clusters of white minerals. These clasts are derived from erosion of the Precambrian Purcell Lava, a volcanic rock exposed north of this area. They are characteristic of debris deposited by or derived from the northern glacier which once occupied Kalispell Valley; they have not been found in deposits of the Swan River glacier. This outwash was probably deposited by glacial meltwaters of the northern glacier

Ice-contact deposit of northern glacier--Light brown to brown; consists of unconsolidated, well-rounded gravel, cobbles, and boulder in a sandy matrix. Virtually all clasts are well rounded; no angular or subangular clasts were found. Although the deposit consists chiefly of coarse meterial, locally it grades laterally into a fine to coarse sand with included small pebbles and pode of gravel, and eventually into areas of uncon-olidated clean wellsorted sand. Patches of these sandy areas have been reworked by wind to form small dune areas. In general, size analyses of the coarser factes indicate that about 75 percent of unit is composed of clasts that range in size from about 5 mm to about 76 mm (1/4-3 in.) in diameter; about 19 percent consists of a fine to coarse sand with included small pubbles as much as 5 mm in di meter; and the remaining 6 percent is silt. By contrast, analyses of the sandy facies indicate that about 91 percent of the unit consists of a fine to coarse sand with included small pebbles as much as 5 mm with the remaining 9 percent being

Purple, green, and gray argillite clasts dominate deposit; clasts of bluish-gray basalt are minor constituents. Wellrounded boulders about 1.5 m (5 ft) across are scattered through the deposit and across its surface. Fluvially deposited; forms an extensive rolling plain broken locally by small isolated bedrock knolls. Many of these hills are elongate ovals with their long axes trending south as a result of having been shaped when overridden by the south-flowing northern glacier. Surface of the plain is hummocky, and is marked by widespread knob-and-kettle topography in which small kettle lakes and swamps

The origin of the deposit is uncertain; on ltern tive is that it was formed when altwares of a wasting glacier doposited a layer of sand and gravel across a sheet of ice characterized by an irregular surface. Subsequent alt of the ice roulted in the humocky termin. Many of the kettles were probably found when buried ice blocks alted paraliting the overlying sand and gravel to collapse into the resulting voids TILL OF PINEDALE GLACIATION (PLEISTOCENE)

Valley facies--Light tan to light brown; consists of a heterogeneous mixture of gravel, cobbles, and boulders in a partly consolidated silty to clayey matrix. Clasts range in shape from angular to well rounded; most are rounded. Includes many rounded cobbles 8-20 cm (3-8 in.) in diameter, and many angular to subrounded boulders 0.3-1 m (1-3 ft) across. Many large angular to subangular boulders, 2.5-3 m (8-10 ft) across, are scattered through the till and on the surface. Clasts of green, gray, and purple argillite dominate deposit. Confined to the southeast corner of this quadrangle. Characterized by a knob-and-kettle topography marked by many small kettle lakes and swamps. East of this quadrangle, at the northern end of Swan Lake, a few alined drumlinoid knobs suggest general northwest direction of movement of Swan River trunk glacier that deposited and overrode this till. This till is part of the crescentic-shaped terminal(?) moraine formed at the north end of Swan Lake when the north-flowing Swan River glacier reached its farthest northern extent

> Foothill facies--Light brown to brown; consists of an unsorted mixture of gravel, cobbles, and boulders in a silty to clayey matrix. Clasts range in shape from an ular to subrounded; most are subangular. Most clasts range from 0.1 to 6 cm (1/2-2 1/2 in.) across. Boulders 0.5-4.5 m (2-15 ft) across are common. Clasts of green, gray, and purple argillite, of tan dolomite, and of tan quartzite and sandstone appear to be equally profuse. Of uncertain extent; confined to the southeast corner of this quadrangle. Forms a veneer of variable thickness over bedrock; extensively mantled by colluvium. Source of this till is unknown; likely it was deposited by an older glacier that flowed north in ancestral Swan River valley prior to the advent of the younger glacier responsible for the drift that now mantles most of the valley floor. It may have been deposited, however, by an older glacier that flowed southward up the ancestral Swan River valley

Otvn TILL OF THE NORTHERN GLACIER (PLEISTOCENE) --Light tan, light gray, and grayish brown. Consists of a heterogeneous mixture of partly consolidated gravel, cobbles, and boulders in a sandy to silty matrix. Clasts range in shape from angular to subrounded. Size range of most clasts is 1-6 cm (1/2-2 1/2 in.). Includes many well-rounded cobbles 8-20 cm (3-8 in.) in diameter; boulders range from 0.3 to 7.6 m (1-25 ft) across with most being 0.3-0.5 m (1-2 ft) in diameter. Large glacial erratics 3-4.5 m (10-15 ft) are profuse and are scattered irregularly through the till and across the surface. Clasts of purple and green argillite, and of bluish-gray limestone dominate deposit; tan quartzite and sandstone are minor constituents. Forms a veneer of variable thickness over bedrock

> BEDROCK OF BELT SUPERGROUP, UNDIVIDED (PRE-CAMBRIAN Y) -- Consists of several units of the Belt Supergroup, chiefly the Spokane (argillite and siltite), Empire (argillite and siltite), and Helena (dolomite) Formations. These are bright units in varying shades of red, purile, green, tan, and gray

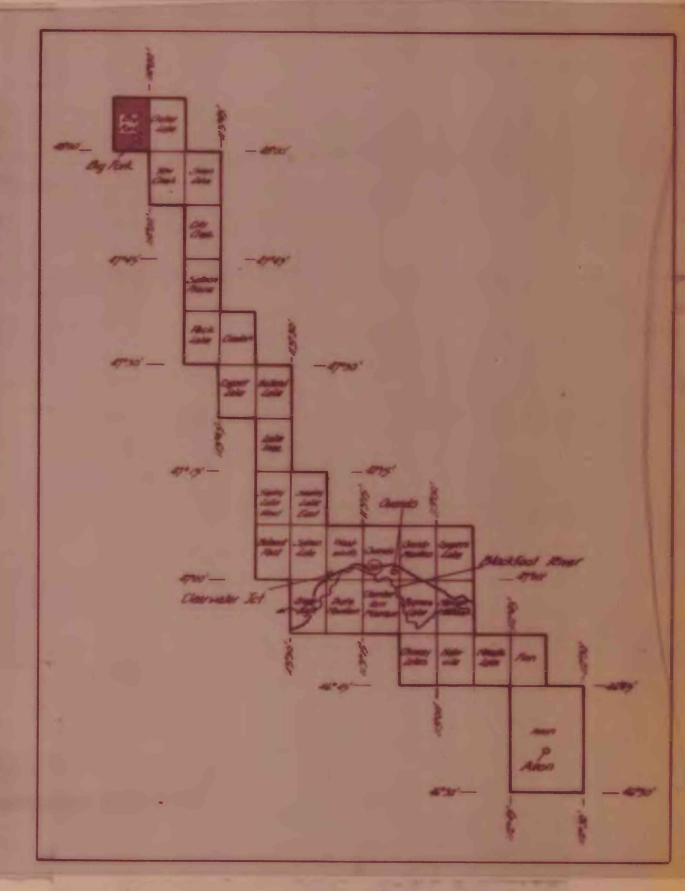
CONTACT--Approximately located or inferred.

In many places wholly or partly concelled by debris or dense foliage

or FAULT--Dashed where pproximately located or inferred; dotted where conceal d.

U, upthrown side; D, downthrown side

"" EMBANKMENT



Index map showing quadrangles in the Big Fork-Avon area. The Big Fork quadrangle is shaded. Preliminary surficial geologic maps of the following quadrangles, by I. J. Witkind, are available as U.S. Geological Survey Open-File Reports from the:

Open-File Services Section, Branch of Distribution, Box 25425, Federal Center, Denver, Colorado 80225

Copies of the maps can be examined at the following offices:

Denver Public Inquiries Office, U.S. Geological Survey, 1012, Federal Building, 1961 Stout Street,

Denver, Colorado 80202

Salt Lake City Public Inquiries Office, U.S. Geological Survey, 8015, Federal Office Building, 125 South State Street Salt Lake City, Ut h 84111

Spokane Public Inquiries Office, U.S. Geological Survey, 678, U.S. Courthouse Building, West 920 Riverside Avenue, Spokane, Washington 99201

1.	Big Fork	78-174
2.	Cilly Creek	77-860
3.	Condon (W. half)	77-540
4.	Coopers Lake (S. half)	77-466
5.	Crater Lake (W. half)	78-173
6.	Cygnet Lake	77-198
7.	Holland Lake (W. half)	77-199
8.	Lake Inez	77-200
9.	Ovando	77-196
10.	Ovando Mountain (5. half)	77-465
11.	Peck Lake (E. half)	77-539
12.	Salmon Lake	77-197
13.	Salmon Prairie	77-861
14.	Seeley Lake East	77-202
15.	Secley Lake West	77-201
16.	Swan Lake (SW quarter)	78-135
17.		77-203
18.	Yew Creek (NE quarter)	78-136

REFERENCE

Johns, W. M., 1970, Geology and mineral deposits of Lincoln and Flathead Counties Mont.: Montana Bur. Mines and Geology Bull. 79



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